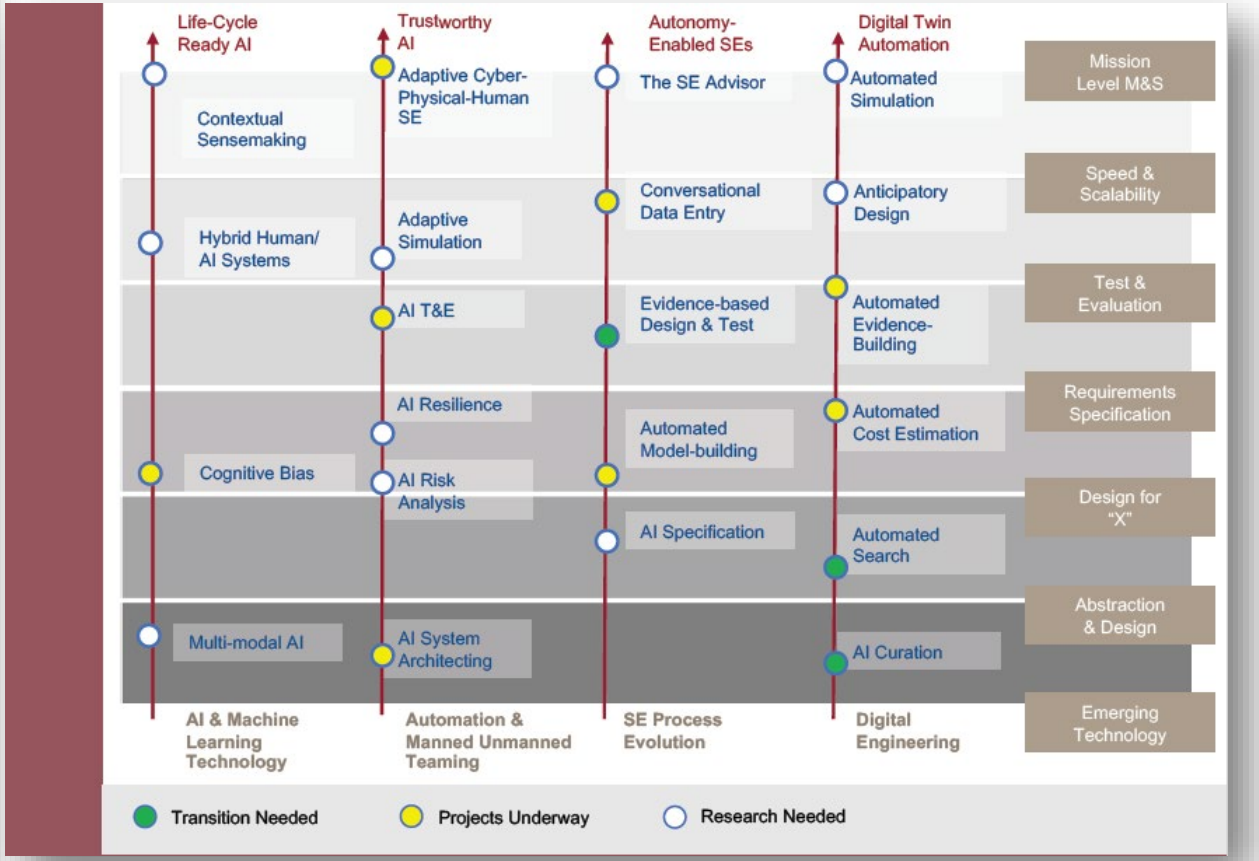
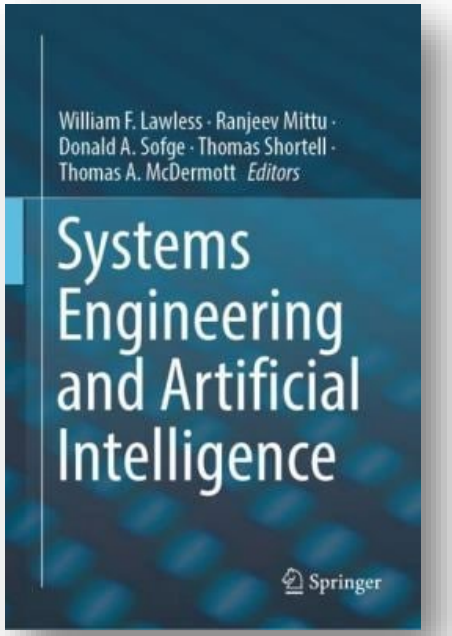
Tom McDermott, Systems Engineering Research Center

Roadmap for AI and SE

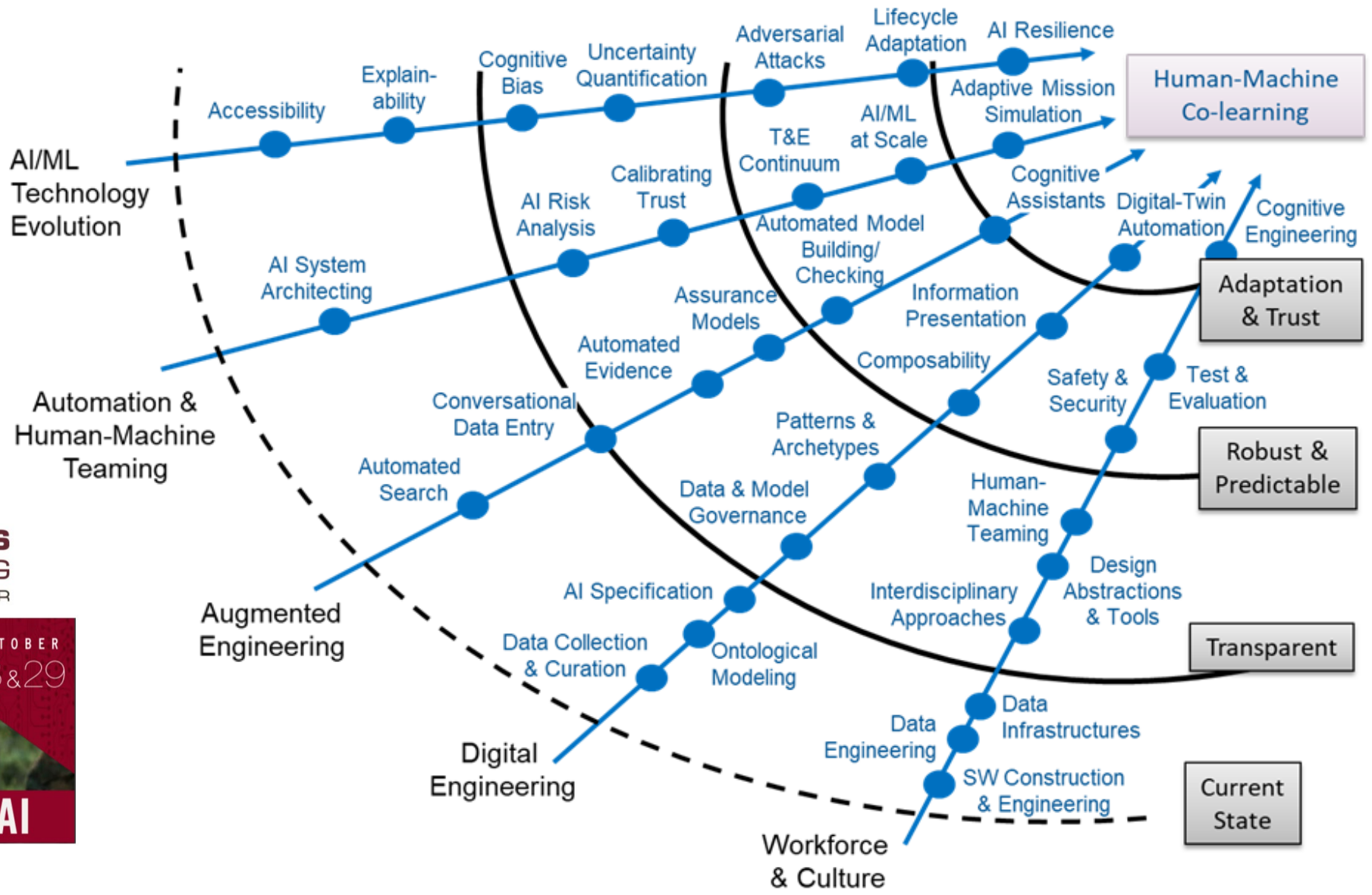
Initial SERC AI Roadmap



Current AI Roadmap



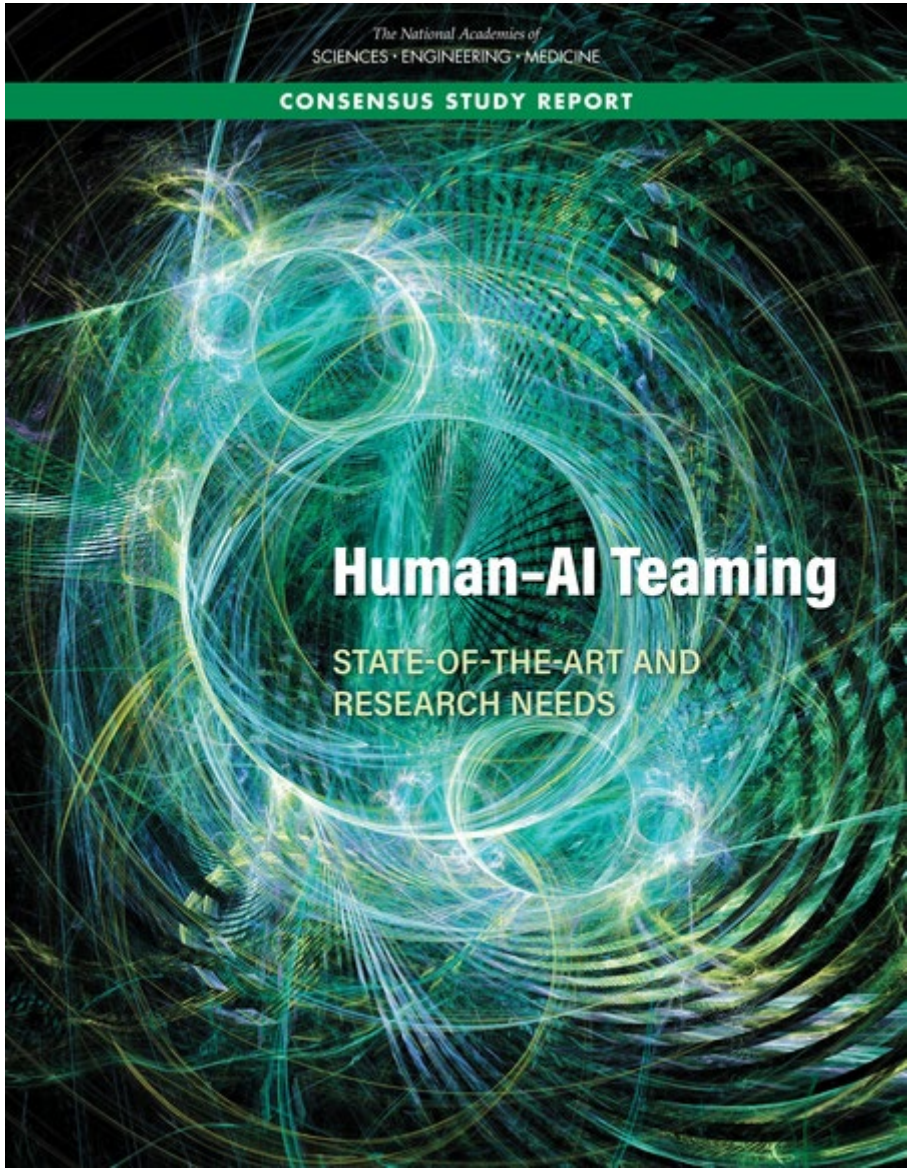
SYSTEMS ENGINEERING RESEARCH CENTER



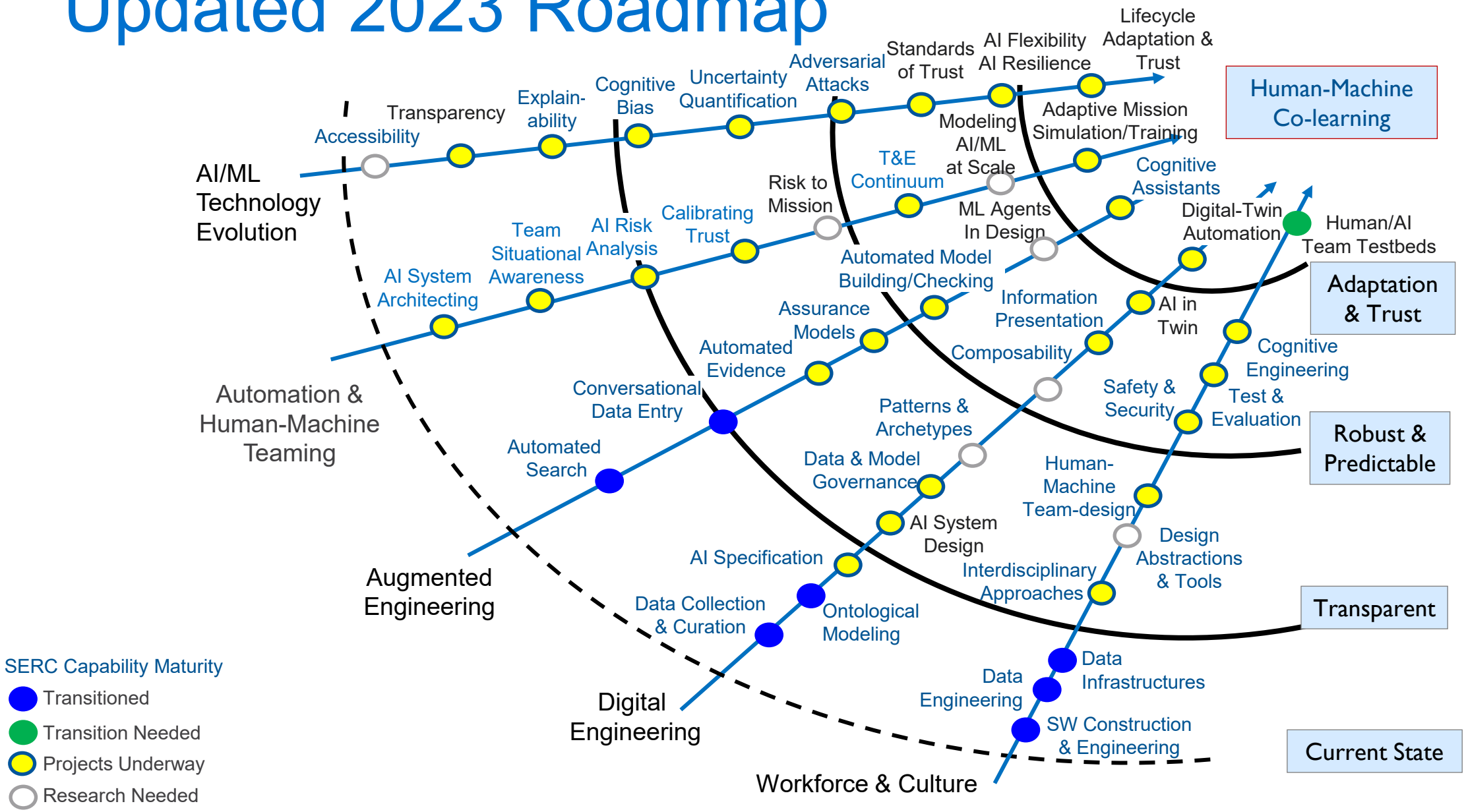
SE/HSI Objectives

Significant value in considering the human and AI as a team

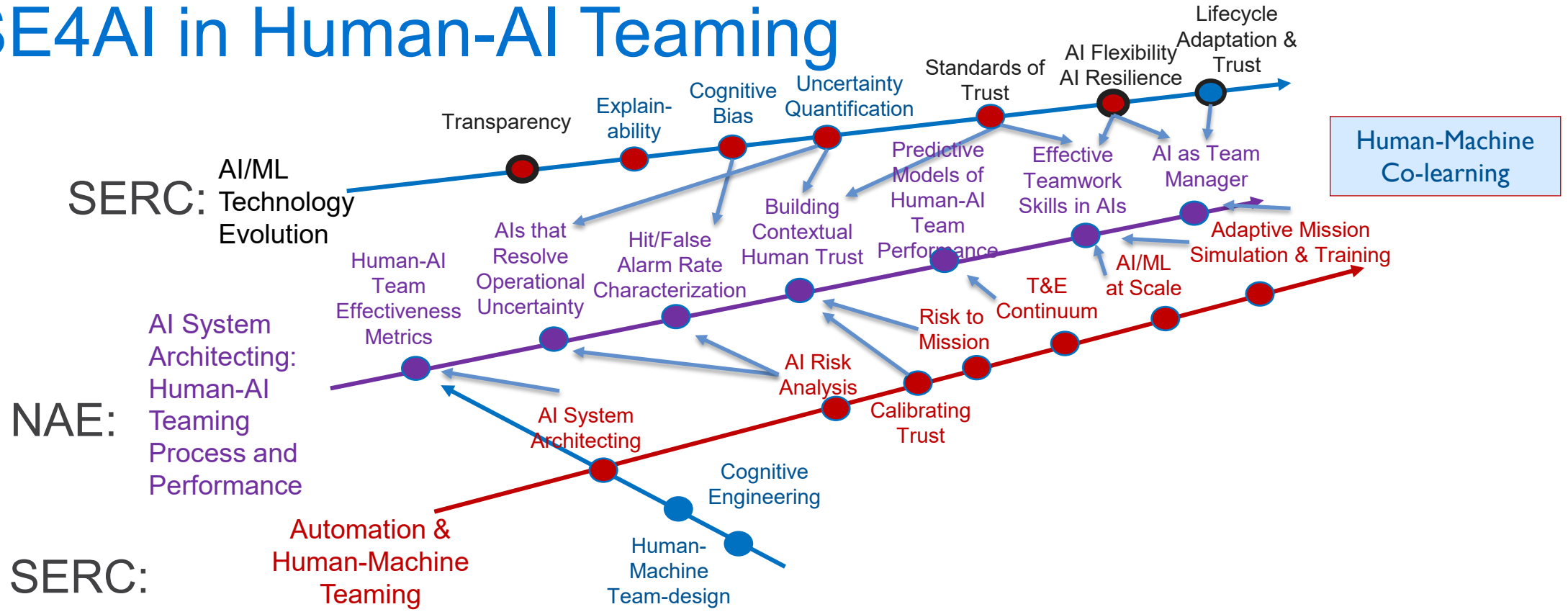
- Long-term, distributed, and agile human-AI teams through improved team assembly, goal alignment, communication, coordination, social intelligence, and the development of a new human-AI language – **AI System Architecting**
- Methods for improving human situational awareness of AI systems
- Improved AI system transparency and explainability
- Interaction mechanisms and strategies within the human-AI team
- Advance understanding of how broader sociotechnical factors affect trust in human-AI teams
- Better understand the interdependencies between human and AI decision-making biases, how these evolve over time, and methods for detecting and preventing bias
- What, when, why, and how to best train human-AI teams
- **Advances in HSI processes and measures**



Updated 2023 Roadmap



SE4AI in Human-AI Teaming



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- Advances in HSI processes and measures

INCOSE

International Council on Systems Engineering

Dr. Barclay Brown
Collins Aerospace

Dr. Ramakrishnan Raman
Honeywell Inc.

Tom McDermott
SERC

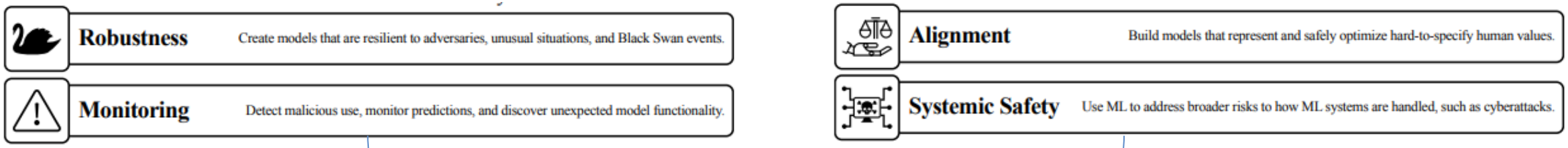
Dr. Ali K. Raz
George Mason University

Dr. Ali Raz, Co-Chair INCOSE AI Working Group

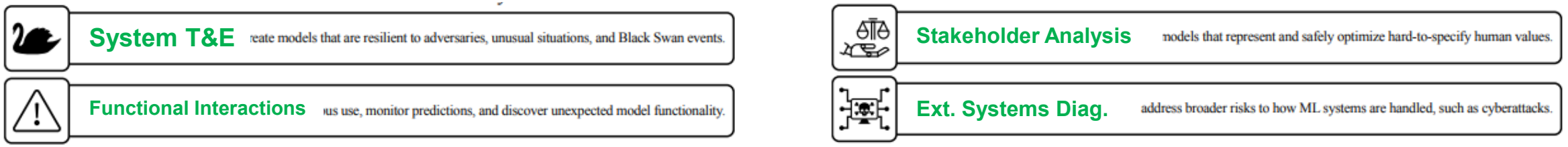
INCOSE AI Working Group

AI/ML Call for Systems Engineering

Unsolved Problems in ML Safety*



Systems Engineering and AI



INCOSE AI Working Group Charter

- Established under the Future of Systems Engineering (FuSE) initiative in 2019
- Disseminate AI knowledge in systems engineering community
- Explore evolution of systems engineering for AI systems and AI application to systems engineering principles
- Get INCOSE recognized as a resource of expertise for research, development, and application of AI in systems

Hendrycks, Dan, Nicholas Carlini, John Schulman, and Jacob Steinhardt. "Unsolved problems in ml safety." *arXiv preprint arXiv:2109.13916* (2021)

AIWG Educational Activities

Artificial Intelligence for Systems Engineers:

Going Deep With Machine Learning and Deep Neural Networks

- Full day tutorial designed for Systems Engineers
- Offered at INCOSE International Symposium 2021, 2022, and 2023

Part I: Introduction to AI

- Brief introduction and history of AI
- Three waves of AI
- Introduction to Machine Learning
- Introduction to Neural Networks
- Explainable AI
- Participants perspective on Why AI matters for SE?

Part II: Going Deep into Deep Neural Networks

- Fundamental concepts of a neural network
- How deep neural networks really work?
- One Page NN
- Non-linear functions and multiple hidden layers
- Convolutional neural networks for image recognition
- Data Hunt Exercise
- Data Requirements

Part III – Intro NLP, RNN, RL, and Data Requirements

- Natural Language Processing (NLP) and word embeddings
- Large Language Models
- Recurrent Neural Networks for machine translation
- Reinforcement Learning and Explainable AI
- What now? How to learn to develop neural networks

Part IV: AI in the Systems Lifecycle

- AI Model Development Process
- Systems Engineering for AI
- AI for Systems Engineering
- Where to go next for learning AI
- Reflections: Why AI matters for SE?
- Q&A

AI Explorer Series – Emerging Trends in AI

- AI Explorer events feature two brief (TED-style) talks on key AI developments
  - Hour long virtual session
  - 12-15min invited presentations
  - 30-min open discussion
- Sample of previous AI explorer events
  - Exploration AI & MBSE: Use Cases in Aircraft design *(Fabien Bouffaron, Airbus)*
  - Ad-hoc Data Exploration using Conversational AI *(Anand Ranganathan, Unscrambl)*
  - Human-AI collaborative knowledge discovery in tradespace exploration *(Dr. Dani Selva, Texas A&M University)*
  - Co-design of Trustworthy AI and Systems *(Dr. Zoe Szajnfarber, George Washington University)*
  - A System Engineer's Guide to Explainable AI *(Dr. Ali Raz, George Mason University)*
- All sessions are recorded and available to AI WG members

SERC-INCOSE Virtual Workshop

Balancing Opportunity and Risk: The Systems Engineer's Role in the Rapid Advancement of AI-Based Systems

- Virtual and unlimited participation
- Open to global audience and presenters
- Register online